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Testing the Threshold Asymmetric Co-integration Interest Rate Pass-Through in the Presence of Stylised Properties: Evidence from Pakistan

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The study examines the existence of interest rate pass-through between retail interest rates and policy rates in Pakistan using monthly data from January 2004 to March 2017. Both retail interest rates and policy rates follow stylised properties of financial time series. Therefore, the EC-E-GARCH-M model is used to estimate the interest rate pass-through between retail and policy rates as suggested by Wang and Lee (2009). Empirically, there is an incomplete pass-through from policy rates to retail interest rates, which is 73 percent basic points. This rate of pass-through is higher compared to previous studies for Pakistan. The results also highlight that there is an upward rigidity in the deposit rate model.

JEL Classifications: C22, C58,
Keywords: EC-E-GARCH-M Model, Interest Rate Pass-Through, Stylised Properties, Threshold Asymmetric Cointegration, Rigidities

1. INTRODUCTION

The interest rate pass-through mechanism is one of the crucial gateways for the central bank to achieve the goals of monetary policy. The central bank can manage the retail interest rate by regulating the policy rate. Therefore, monetary policy affects the outcome of financial institutions. The margin, markup, markdown, and the speed of pass-through are the different estimates of interest rate pass-through (Bredin et al. 2002 and Bondt, 2002). In industrialised countries, the central bank uses several channels to implement the monetary policy (Fuertes and Heffernan, 2009). However, this option is not available in the case of developing countries. One of the essential tools that the central bank can use to change the policy rate is to achieve inflation targets. This tool of the monetary policy successfully controls future expenditure and the inflation rate.

During the different stages of business cycles, when the central bank changes its monetary policy, the policy rate is also affected. As a result, financial institutions change profit margins. In this process, the central bank transfers costs to commercial banks, and commercial banks further transfer this cost to their consumers. This process of transferring cost from the central bank to consumers is called the interest rate pass-

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through effect. There is a possibility of over, under, or no interest rate pass-through. In general, no matter what kind of pass-through it is, there is a long-run relationship between different types of interest rates, and this relationship ensures the efficiency of the monetary policy.

The main objective of the monetary policy is to increase economic growth, which can only be achieved by understanding the mechanism of interest rate pass-through. For example, if the level of pass-through is low, the monetary policy will be wholly ineffective, and vice versa. Empirically, some studies have been conducted to find interest rate pass-through in Pakistan (Qayyum et al. 2005, Khawaja et al. 2008, Mohsin 2011, Hanif and Khan 2012, Hassan et al. 2012, Fazal et al. 2013, Mahmood 2018). All these studies have used the symmetric cointegration model to estimate interest rate pass-through except Mahmood (2018). The symmetric cointegration models are biased due to the presence of asymmetric information and asymmetric adjustment in the error correction model. Mainly, there are two hypotheses for the asymmetric effect, i.e., the consumer behaviour hypothesis and the bank concentration hypothesis (Karagiannis et al. 2010). Symmetric cointegration and error-correction models do not consider the asymmetric adjustment of interest rates, so the estimation results tend to reject the pass-through mechanism.

Further, the traditional error correction model ignores the effect of interest rate volatility. Therefore, the model may not be able to correctly explain the adjustment process of the interest rate in the short-term. Some studies have used KIBOR as a proxy for the policy rate, which is not an appropriate measure because KIBOR is itself dependent upon the policy rate which is set by the State Bank of Pakistan (Hassan et al. 2012, Mahmood, 2018). The present study used the T-Bill rate as a proxy for the policy rate.

Qayyum et al. (2005) have estimated the interest rate pass-through by using 6-month deposit and lending rates, while the 6-month T-bill rate was taken as policy rate. The study has found a very low degree of pass-through in the impact period and significant pass-through after 4-5 lags. It implies that the pass-through will affect after 2 to 2.5 years, which does seem appropriate economically. Later, Hassan et al. (2012) have discussed the same issue using monthly data. The study has used KIBOR as a policy rate instead of the T-bill rate. The estimated results have shown a low rate of pass-through. Khawaja et al. (2008) have also evaluated the pass-through and have concluded that there is an immediate pass-through to the deposit rate, while in the case of the lending rate, it takes about 1 to 1.5 years.

Hanif and Khan (2012) have used ARDL estimation method to estimate interest rate pass-through and have confirmed the existence of asymmetry. Fazal et al. (2013) have improved upon the Qayyum et al. (2005) model by using monthly data and have found a low degree of pass-through. The study has also confirmed that there is a low rate of pass-through both in lending and deposit rates (Mohsin, 2011). Mahmood (2018) using threshold co-integration has concluded that an asymmetric relation exists between wholesale and retail interest rates and that the rate of pass-through is incomplete. Likewise, in the long-run, retail interest rates are rigid towards the downwards adjustment while there is an upward adjustment in the error correction mechanism.

The present study uses the methodology of Wang and Lee (2009) and Mahmood (2018), to estimate interest rate pass-through. The main difference between our research and Mahmood (2018) is the choice of the policy rate, i.e. T-Bill

rate and KIBOR, respectively. Based on this difference, the primary objective of the present study is to compare the empirical result of these two studies, and additionally, to find the difference in empirical findings and policy implications due to change in policy rate variable.

An understanding of the interest rate pass-through hypothesis is essential as it directly relates to consumer behaviour, which ultimately determines future economic growth through the investment channel, and the success of the monetary policy. However, the estimation of the interest rate pass-through via improper estimation methods will lead to false conclusions and misleading implications. Furthermore, the financial time series exhibits stylised properties. Therefore, the symmetric error correction model cannot be an appropriate choice of an econometric model for the estimation of interest rate pass-through as previously done by Qayyum et al. (2005), Hassan et al. (2012), and Fazal et al. (2013).

The rest of the paper is organised as follows:

Section 2: data and methodology.
Section 3: empirical results.
Section 4: conclusion.

2. DATA AND METHODOLOGY

For empirical analysis, monthly data is used to examine the asymmetric cointegration for the interest rate pass-through mechanism. The variables used are deposit rate, lending rate, and T-Bill rate. Deposit and lending rates are weighted averages for a whole month, while the T-Bill rate is the 3-month Treasury bill rate. The data is taken from the State Bank of Pakistan (SBP). Data is selected for the period 2004M1 to 2017M3.

The methodology is in three steps. In the first step, the long-run relationship between policy rates and retail rates is examined by using the Engle and Granger (1987) test. In the second step, asymmetries in interest rate pass-through are investigated by using the Chan (1993) methodology.

2.1. Threshold Cointegration Test

Before applying the cointegration test, the first stationarity of the variables is examined. If variables are stationary at first difference, then there is a possibility of a cointegrating relationship between variables. The Engel and Granger (1987) test is used for cointegration analysis. The financial time series exhibits volatility; therefore, the cointegration relationship may not be symmetric. To find asymmetric cointegration among variables, TAR, and MTAR models will be used (Enders and Siklos, 2001).

If all variables are stationary at first difference, then the Engle and Granger (1987) cointegration test can be applied to estimate the following linear model:

$$Y_{1t} = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} \ \ldots + \beta_n X_{nt} + e_t, \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where β_i's are the parameters to be estimated, e_t represents error term. If the error term is stationary at the level, it implies the existence of a long-run cointegration relationship. For this purpose, unit root test will be applied on error term:

$$\Delta e_t = \rho e_{t-1} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where ε_t is a white noise process. In the symmetric model, it doesn't matter if e_{t-1} is positive or negative, the changes in the value of e_t equals ρ times e_{t-1}. However, there will be a misspecification problem if there is asymmetry in the long-run equilibrium relationship in Equation (1). Enders and Granger (1998) and Enders and Siklos (2001) presume that in long-run positive and negative shocks in error cause asymmetric adjustments. These asymmetric adjustments can be tested through the TAR model in a long-run equilibrium relationship. Now the model can be written as:

$$\Delta e_t = I_t \rho_1 e_{t-1} + (1 - I_t)\rho_2 e_{t-1} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where I_t represents an indicator variable, specified of the form

$$I_t = \{1 \text{ if } e_{t-1} \geq \tau \quad \text{or} \quad I_t = \{0 \text{ if } e_{t-1} < \tau \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

Equation (4) stipulates that τ is a threshold when e_{t-1} is greater or equal to τ (threshold value), ρ_1 is the adjustment parameter and $\rho_1 e_{t-1}$ represents the adjustment margin. When τ is higher than e_{t-1}, the adjustment parameter and the adjustment margin are ρ_2 and $\rho_2 e_{t-1}$, respectively.

True characteristics of the nonlinear model are still unknown. Therefore, Enders and Siklos (2001) assumed that Δe_{t-1} could represent the momentum of interest rate adjustment and reveal the asymmetric change of the interest rate. This asymmetric TAR model is called momentum TAR (MTAR) model and is specified as follows:

$$\Delta e_t = M_t \rho_1 e_{t-1} + (1 - M_t)\rho_2 e_{t-1} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

Where M_t is the indicator variable, which is as

$$M_t = \{1 \text{ if } \Delta e_{t-1} \geq \tau \quad \text{or} \quad M_t = \{0 \text{ if } \Delta e_{t-1} < \tau \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

where M is greater or equal to τ (threshold value), the ρ_1 is the adjustment parameter and $\rho_1 e_{t-1}$ is the adjustment margin. In turn, when τ is higher than e_{t-1}, the adjustment parameter and adjustment margin are ρ_2 and $\rho_2 e_{t-1}$, respectively. If autocorrelation also exists in Equations (3) and (5), then the revised form of TAR and MATR models can be written as follows:

$$\Delta e_t = I_t \rho_1 e_{t-1} + (1 - I_t)\rho_2 e_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta e_{t-1} + \varepsilon_t \quad \ldots \quad \ldots \quad (7)$$

$$\Delta e_t = M_t \rho_1 e_{t-1} + (1 - M_t)\rho_2 e_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta e_{t-1} + \varepsilon_t \quad \ldots \quad \ldots \quad (8)$$

where $-2<(\rho_1, \rho_2)<0$ is the sufficient condition for the error term series (e_t) to be stationary, and then it does not depend on which model Equation (7) or Equation (8) is chosen. The OLS estimators of ρ_1 and ρ_2 are consistent estimators according to F distribution only when e_t is stationary and has a known value of the threshold.

Enders and Siklos (2001) have used the F statistics for the examination of the asymmetric co-integration. If the null hypothesis is $\rho_1 = \rho_2 = 0$ is rejected, then it confirms the existence of co-integration. However, the symmetric adjustment process can be tested with the null hypothesis of $\rho_1 = \rho_2$. Rejection of the null hypothesis implies that the asymmetric adjustment of long-run relationship.

2.2. Introduction of Error Correction Term in the EGARCH-M Model

The present study applies the Engle and Granger (1987) test to the following model, which shows the long-run relation of the retail interest rate with the policy rate:

$$R_t = d_0 + d_1 M_t + e_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

where R_t the retail interest rates, M_t stands for the policy rate and e_t is the error term for the long-run. Parameter d_0 captures the fixed margin upon retail interest rate, while parameter d_1 captures the speed of pass-through. If $d_1 < 1$, it indicates incomplete pass-through. If d_1=1, it shows the complete pass-through and if d_1> 1 it means pass-through is more significant. Based on Equation (9), the asymmetric EC-E-GARCH(1, 1)-M model can be written as follow:

$$\Delta R_t = d_0 + d_1 \Delta MI_t + \sum_{i=1}^{m} a_i \Delta R_{t-i} + \sum_{i=1}^{n} b_i \epsilon_{t-i} + c\sigma_t^{\delta} + +\eta_1 M_t \hat{e}_{t-1} + \eta_2 (1 - M_t)\hat{e}_{t-1} + \varepsilon_t$$

$$\varepsilon_t = z_t \sigma_t$$

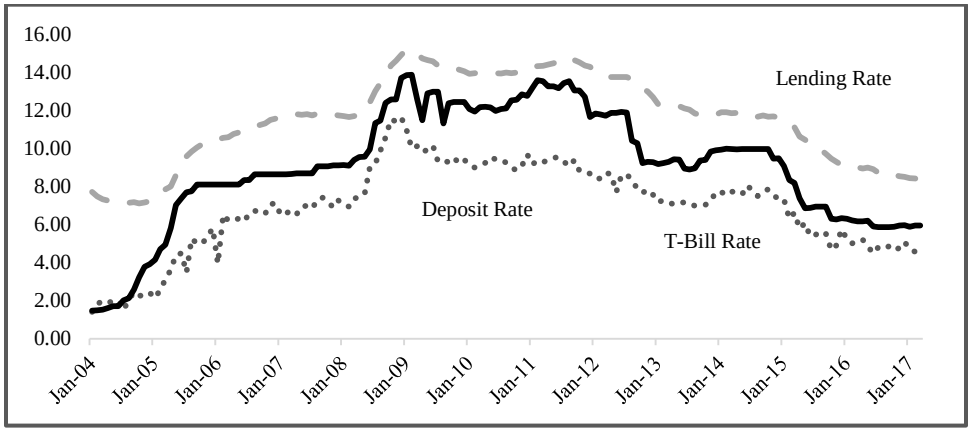
$$\sigma_t^{\delta} = \alpha_0 + \sum_{i=1}^{q} \alpha_i y_{t-i}^2 + \sum_{i=1}^{p} \beta_j h_{t-i} + \theta_1 (abs(\varepsilon_{t-i}) - \gamma_i \varepsilon_{t-i})^{\delta} + \theta_2 \sigma_{t-j}^{\delta} \quad (10)$$

Equation (10) represents the general model for EC-ARMA-EGARCH-M, in the presence of asymmetric adjustment in the short-run along with the error correction. It is also used to capture the rigidities in retail interest rates, by testing different restrictions on parameters of MTAR model's parameter (for detail see Wang and Lee 2009, Mahmood 2018).

3. EMPIRICAL RESULTS

3.1. Data Description

Visualisation is essential to study the different time series properties of data sets. Otherwise, empirical results and inference could be misleading. Variables are plotted in Figure 1. The figure reveals that all rates, i.e., lending rate, deposit rate, and T-bill rate, have the same pattern. All rates first increase, after reaching the maximum level they start decreasing. The T-Bill rate has more volatility which is also followed by the deposit rate



but with lesser volatility. The lending rate has less volatility. It implies that due to change of the T-Bill rate, there is a high rate of pass-through to the deposit rate and lower rate of pass-through to lending rate. It also indicates the possibility of cointegration among these variables, i.e. when the value of the T-Bill rate increases, then lending and deposit rates also increase and vice versa.

Table 1 provides the ADF and Phillips and Perron (PP) unit root results. The empirical results imply that all the series are not stationary at levels but are stationary at first differences.

Table 1

Unit Root Test Results

	Level		1st difference	
	ADF	PP	ADF	PP
Deposit Rate	–1.4983	–1.6456	–16.8815***	–16.7594***
Lending Rate	–1.7488	–0.6546	–4.2520***	–5.9521***
T-Bill Rate	–1.8919	–1.7841	–11.4791***	–11.4977***

Note: The critical values refer to Mackinnon (1996). ***indicate that the value is significant at 1 percent level.

3.2. Co-integration Test

Table 2 provides the long-run parameters for the deposit and lending rate models. It is estimated that there is a fixed markup for both models. However, the level of markup is higher in the case of the lending rate as compared to the deposit rate from the T-Bill rate. Furthermore, the pass-through is the same in both models, and this pass-through is higher than the previous literature. However, there is an incomplete pass-through as whenever the State Bank of Pakistan changes monetary policy, the commercial banks do not have enough power to transfer their total cost to consumers by improving the retail interest rates because there are already insufficient consumers dealing with banks. In this scenario, if the pass-through ratio increases, then the variability in the business cycle of banks will also increase (Khan et al. 2012).

Table 2

Estimation of Long-run Parameters

	Long-run Model	
	Deposit Rate	Lending Rate
d_0	0.2808*	4.9342***
d_1	0.7322***	0.7337***
H_0: $d_1 = 1$	273.23***	334.14***

Note: *** and *indicate that the value is statistically significant at 1 percent and 10 percent levels, respectively.

3.3. Error Correction Results

To confirm the existence of co-integration between the policy rate and the retail rates, TAR and MTAR models are employed. Empirical results of TAR and MTAR models are presented in Table 3. The null hypothesis of $H_0: \rho 1 = \rho 2 = 0$ is rejected in both models. It confirms the existence of cointegration among the retail rates. Similarly,

the null hypothesis of $H_0: \rho_1 = \rho_2$ is rejected in both models which confirms the existence of the asymmetric relationship. It indicates that asymmetric cointegration exists among policy rates and retail rates.

Table 3

TAR and MTAR Cointegration Results

	Co-integration			
	TAR		MTAR	
	F-value		F-value	
Deposit Rate	104.09***	Co-integration	40.97***	Co-integration
Lending Rate	287.23***	Co-integration	113.45***	Co-integration
	Symmetric/Asymmetric			
Deposit Rate	46.19***	Asymmetric	41.99***	Asymmetric
Lending Rate	3.44**	Asymmetric	13.29***	Asymmetric

Note: *** and ** indicate that the value is statistically significant at 1 percent and 5 percent levels, respectively.

Table 4 provides the estimated results of error correction in EGARCH-M model for the deposit and lending rates. The results of the deposit rate model imply that there is a low rate of pass-through due to policy rate change. Furthermore, positive values have higher error correction estimates than negative values. The null hypothesis $\eta_1 = \eta_2$ is rejected which implies that there is asymmetric error correction. Moreover, it is found that there is an upward rigidity ($\eta_1 > \eta_2$) in deposit rate model. Finally, there exists an asymmetric effect of bad news, which is exponential in the deposit rate behaviour. The results of the lending rate model show that there is quite a low rate of pass-through from the policy rate as compared to the deposit rate model. Furthermore, the positive and negative indicators have a similar error correction mechanism and also implies symmetric error correction.

Table 4

Results of the Error Correction in EGARCH-M Model

	Deposit Rate Model	Lending Rate Model
Interest Model	EC-E-GARCH (1,1) – M	EC-E-GARCH (1,1) – M
d_0	0.1883***	–0.0079
d_1	0.2199**	0.0968***
η_1	–0.4047***	–0.0753***
η_2	–0.0207	–0.0718***
w	–2.0074***	–4.3461***
α_1	–0.4198***	0.8616
β_1	0.6758***	0.5322***
θ_1	0.8436***	0.0022
θ_2	–0.2698**	0.6394**
c	–1.1558***	–0.0276

Note: *** (**) indicate that the value is statistically significant at 1 percent (5 percent) level.

The results reveal that there is an incomplete rate of pass-through i.e., 73 percent basic points between the retail interest rate due to a change in the policy rate. The results imply that borrowing from the domestic banks for investment is more efficient as banks have low power to transfer the cost to their consumer. The deposit rate is rigid upward, which implies that commercial banks will always try to give a low rate of profit to their consumers while borrowers from the bank have a higher power to reduce to the level of margin. Hence based on the empirical results of the study it is concluded that the profit margin of commercial banks depends on the power of rigidity of the borrower, i.e., if the power of rigidity is weak, then it will increase the profit margin, and vice versa.

Furthermore, one objective of the present study is to compare the empirical result of the present study with Mahmood (2018). Empirically it is found that the rate of the PT in the present study is higher as compared to Mahmood (2018). This difference is because of the appropriate choice of proxy for the policy rate, i.e., T-Bill rate instead of KIBOR.

3.4. The Economic Significance of Empirical Results

Table 5 provides a summary of the empirical results. First, there is asymmetric cointegration between retail interest rates and the policy rate. Second, mark-up exists for both models. Third, it indicates that there is an incomplete pass-through in Pakistan's case. Thus, when policy rate changes, some cost is transferred to commercial banks. To cover this cost, commercial banks adjust the markup ratio in the direction of the central bank.

Table 5

Comparison of Empirical Results

Model	Symmetric/Asymmetric Co-integration	Mark(up/down) (d_0)	Pass-Through Type (d_1)	Adjustment Rigidity (η_1 , η_2)
Deposit Rate	Asymmetric Co-integration	Mark-up	Incomplete	Upward
Lending Rate	Asymmetric Co-integration	Mark-up	Incomplete	No Rigidity

The possible justification for low-interest rates pass-through in Pakistan is mostly because of low consumer sensitivity towards the change in interest rate cost and revenues. In this situation, commercial banks will not maximise their profit; and hence, the government's economic policies might be ineffective. Consequently, the efficiency of the monetary policy associated with interest rate pass-through would decrease the possibility of achieving its objectives. Therefore, the government of Pakistan must pay close attention to market information and market structure to achieve the objective of the monetary policy.

4. CONCLUSION

The study examines the existence of interest rate pass-through between retail interest rates and the policy rate in Pakistan using monthly data from January 2004 to

March 2017. Retail interest rate and the policy rate follow the stylised properties of the financial time series. Therefore, error correction EGARCH-M model is used to estimate the interest rate pass-through between retail and policy rate, as suggested by Wang and Lee (2009) and Mahmood (2018).

The primary objective of interest rate pass-through is to increase growth through the investment channel, which can only be achieved if the rate of the pass-through is complete. However, in Pakistan, the speed of the pass-through is incomplete. One possible reason is the Islamic culture of the country as people are not attracted by the interest rates. Second, bank deposits are not a significant amount for investment. Hence, the depositors do not have much power to fight against rigidities imposed by the banks. Lastly, due to the insignificant amount of investment, minute changes occur in revenue as compared to the cost. Therefore, the State Bank of Pakistan has to give more attention to the behaviour of the market to achieve the objective of the monetary policy effectively.

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